Claims

1. A mass spectrometer comprising:

an ion trap comprising a plurality of electrodes wherein at a first time t_1 ions enter said ion trap and wherein at a second later time t_2 one or more axial trapping regions are formed or created along at least a portion of the length of said ion trap.

2. A mass spectrometer as claimed in claim 1, wherein at said time t_2 at least 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or more than 30 axial trapping regions are created or formed.

3. A mass spectrometer as claimed in claim 1, wherein at said first time t_1 in the region intermediate the entrance and exit of said ion trap no axial trapping regions are provided along said ion trap.

4. A mass spectrometer as claimed in claim 1, wherein at said first time t_1 one or more axial trapping regions having a first depth are formed, created or exist along at least a portion of the length of said ion trap and wherein at said second later time t_2 one or more axial trapping regions are formed or created which have a second depth, wherein said second depth is greater than said first depth.

5. A mass spectrometer as claimed in claim 4, wherein said second depth is at least x% deeper than said first depth, wherein x is selected from the group consisting of (i) 1%; (ii) 2%; (iii) 5%; (iv) 10%; (v) 20%; (vi)

30%; (vii) 40%; (viii) 50%; (iv) 60%; (x) 70%; (xi) 80%; (xii) 90%; (xiii) 100%; (xiv) 150%; (xv) 200%; (xvi) 250%; (xvii) 300%.

6. A mass spectrometer as claimed in claim 1, wherein said ion trap has an entrance for receiving ions and an exit from which ions exit in use and wherein at said second time t_2 at least some ions have travelled from said entrance at least 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95% or 100% of the axial length of said ion trap towards said exit.

7. A mass spectrometer as claimed in claim 1, wherein the difference between t_2 and t_1 is selected from the group consisting of: (i) 1-100 μs; (ii) 100-200 μs; (iii) 200-300 μs; (iv) 300-400 μs; (v) 400-500 μs; (vi) 500-600 μs; (vii) 600-700 μs; (viii) 700-800 μs; (ix) 800-900 μs; and (x) 900-1000 μs.

8. A mass spectrometer as claimed in claim 1, wherein the difference between t_2 and t_1 is selected from the group consisting of: (i) 1-2 ms; (ii) 2-3 ms; (iii) 3-4 ms; (iv) 4-5 ms; (v) 5-6 ms; (vi) 6-7 ms; (vii) 7-8 ms; (viii) 8-9 ms; (ix) 9-10 ms; (x) 10-11 ms; (xi) 11-12 ms; (xii) 12-13 ms; (xiii) 13-14 ms; (xiv) 14-15 ms; (xv) 15-16 ms; (xvi) 16-17 ms; (xvii) 17-18 ms; (xviii) 18-19 ms; (xix) 19-20 ms; (xx) 20-21 ms; (xxi) 21-22 ms; (xxii) 22-23 ms; (xxiii) 23-24 ms; (xxiv) 24-25 ms; (xxv) 25-26 ms; (xxvi) 26-27 ms; (xxvii) 27-28 ms; (xxviii) 28-29 ms; (xxix) 29-30 ms; or (xxx) > 30 ms.

9. A mass spectrometer comprising:

an ion trap comprising a plurality of electrodes, wherein in use ions received within said ion trap are trapped in one or more axial trapping regions within said ion trap and wherein in a mode of operation said one or more axial trapping regions are translated along at least a portion of the axial length of said ion trap with an initial first velocity and wherein said first velocity is then progressively reduced to a velocity less than or equal to 50 m/s.

10. A mass spectrometer as claimed in claim 9, wherein said first velocity is progressively reduced to a velocity selected from the group consisting of: (i) less than or equal to 40 m/s; (ii) less than or equal to 30 m/s; (iii) less than or equal to 20 m/s; (iv) less than or equal to 10 m/s; (v) less than or equal to 5 m/s; and (vi) substantially zero.

11. A mass spectrometer comprising:

an ion trap comprising a plurality of electrodes, wherein in use ions received within said ion trap are trapped in one or more axial trapping regions within said ion trap and wherein said one or more axial trapping regions are translated along at least a portion of the axial length of said ion trap with an initial first velocity and wherein said first velocity is then progressively reduced to substantially zero.

12. A mass spectrometer as claimed in claim 11, further comprising a device for temporally or spatially dispersing a group of ions according to a physico-chemical property, said device being arranged upstream of said ion trap.

13. A mass spectrometer as claimed in claim 12, wherein said physico-chemical property is mass to charge ratio.

14. A mass spectrometer as claimed in claim 13, wherein said device comprises a field free region wherein, in use, ions which have been accelerated to have substantially the same kinetic energy become dispersed according to their mass to charge ratio.

15. A mass spectrometer as claimed in claim 14, wherein said field free region is provided within an ion guide.

16. A mass spectrometer as claimed in claim 15, wherein said ion guide is selected from the group consisting of: (i) a quadrupole rod set; (ii) a hexapole rod set; (iii) an octopole or higher order rod set; (iv) an ion tunnel ion guide comprising a plurality of electrodes having apertures through which ions are transmitted, said apertures being substantially the same size; (v) an ion funnel ion guide comprising a plurality of electrodes having apertures through which ions are transmitted, said apertures becoming progressively smaller or larger; and (vi) a segmented rod set.

17. A mass spectrometer as claimed in claim 14, wherein said field free region is maintained, in use, at a pressure selected from the group consisting of: (i) greater than or equal to $1x10^{-7}$ mbar; (ii) greater than or equal to $5x10^{-7}$ mbar; (iii) greater than or equal to $1x10^{-6}$ mbar; (iv) greater than or equal to $5x10^{-6}$ mbar; (v) greater than or equal to $1x10^{-5}$ mbar; and (vi) greater than or equal to $5x10^{-5}$ mbar.

18. A mass spectrometer as claimed in claim 14, wherein said field free region is maintained, in use, at a pressure selected from the group consisting of: (i) less than or equal to $1x10^{-4}$ mbar; (ii) less than or equal to $5x10^{-5}$ mbar; (iii) less than or equal to $1x10^{-5}$ mbar; (iv) less than or equal to $5x10^{-6}$ mbar; (v) less than or equal to $1x10^{-6}$ mbar; (vi) less than or equal to $5x10^{-7}$ mbar; and (vii) less than or equal to $1x10^{-7}$ mbar.

19. A mass spectrometer as claimed in claim 14, wherein said field free region is maintained, in use, at a pressure selected from the group consisting of: (i) between $1x10^{-7}$ and $1x10^{-4}$ mbar; (ii) between $1x10^{-7}$ and $5x10^{-5}$ mbar; (iii) between $1x10^{-7}$ and $1x10^{-5}$ mbar; (iv) between $1x10^{-7}$ and $5x10^{-6}$ mbar; (v) between $1x10^{-7}$ and $1x10^{-6}$ mbar; (vi) between $1x10^{-7}$ and $5x10^{-7}$ mbar; (vii) between $5x10^{-7}$ and $1x10^{-4}$ mbar; (viii) between $5x10^{-7}$ and $5x10^{-5}$ mbar; (ix) between $5x10^{-7}$ and $1x10^{-5}$ mbar; (x) between $5x10^{-7}$ and $5x10^{-6}$ mbar; (xi) between $5x10^{-7}$ and $1x10^{-6}$ mbar; (xii) between $1x10^{-6}$ mbar and $1x10^{-4}$ mbar; (xiii) between $1x10^{-6}$ and $5x10^{-5}$ mbar; (xiv) between $1x10^{-6}$ and $1x10^{-5}$ mbar; (xv) between $1x10^{-6}$ and $5x10^{-6}$ mbar; (xvi) between $5x10^{-6}$ mbar and $1x10^{-4}$ mbar; (xvii) between $5x10^{-6}$ and $5x10^{-5}$ mbar; (xviii) between $5x10^{-6}$ and $1x10^{-5}$

mbar; (xix) between $1x10^{-5}$ mbar and $1x10^{-4}$ mbar; (xx) between $1x10^{-5}$ and $5x10^{-5}$ mbar; and (xxi) between $5x10^{-5}$ and $1x10^{-4}$ mbar.

20. A mass spectrometer as claimed in claim 14, further comprising a pulsed ion source wherein in use a packet of ions emitted by said pulsed ion source enters said field free region.

21. A mass spectrometer as claimed in claim 14, further comprising an ion trap arranged upstream of said field free region wherein in use said ion trap releases a packet of ions which enters said field free region.

22. A mass spectrometer as claimed in claim 12, wherein said physico-chemical property is ion mobility.

23. A mass spectrometer as claimed in claim 22, wherein said device comprises a drift region arranged upstream of said ion trap wherein ions become dispersed according to their ion mobility.

24. A mass spectrometer as claimed in claim 23, wherein said drift region is provided within an ion guide.

25. A mass spectrometer as claimed in claim 24, wherein said ion guide is selected from the group consisting of: (i) a quadrupole rod set; (ii) a hexapole rod set; (iii) an octopole or higher order rod set; (iv) an ion tunnel ion guide comprising a plurality of electrodes having apertures through which ions are transmitted, said apertures being substantially the same size; (v) an ion funnel ion guide comprising a plurality of electrodes

having apertures through which ions are transmitted, said apertures becoming progressively smaller or larger; and (vi) a segmented rod set.

26. A mass spectrometer as claimed in claim 23, wherein said drift region is maintained, in use, at a pressure selected from the group consisting of: (i) greater than or equal to 0.0001 mbar; (ii) greater than or equal to 0.0005 mbar; (iii) greater than or equal to 0.001 mbar; (iv) greater than or equal to 0.005 mbar; (v) greater than or equal to 0.01 mbar; (vi) greater than or equal to 0.05 mbar; (vii) greater than or equal to 0.1 mbar; (viii) greater than or equal to 0.5 mbar; (ix) greater than or equal to 1 mbar; (x) greater than or equal to 5 mbar; and (xi) greater than or equal to 10 mbar.

27. A mass spectrometer as claimed in claim 23, wherein said drift region is maintained, in use, at a pressure selected from the group consisting of: (i) less than or equal to 10 mbar; (ii) less than or equal to 5 mbar; (iii) less than or equal to 1 mbar; (iv) less than or equal to 0.5 mbar; (v) less than or equal to 0.1 mbar; (vi) less than or equal to 0.05 mbar; (vii) less than or equal to 0.01 mbar; (viii) less than or equal to 0.005 mbar; (ix) less than or equal to 0.001 mbar; (x) less than or equal to 0.0005 mbar; and (xi) less than or equal to 0.0001 mbar.

28. A mass spectrometer as claimed in claim 23, wherein said drift region is maintained, in use, at a pressure selected from the group consisting of: (i) between 0.0001 and 10 mbar; (ii) between 0.0001 and 1 mbar; (iii) between 0.0001 and 0.1 mbar; (iv) between 0.0001

and 0.01 mbar; (v) between 0.0001 and 0.001 mbar; (vi) between 0.001 and 10 mbar; (vii) between 0.001 and 1 mbar; (viii) between 0.001 and 0.1 mbar; (ix) between 0.001 and 0.01 mbar; (x) between 0.01 and 10 mbar; (xi) between 0.01 and 1 mbar; (xii) between 0.01 and 0.1 mbar; (xiii) between 0.1 and 10 mbar; (xiv) between 0.1 and 1 mbar; and (xv) between 1 and 10 mbar.

29. A mass spectrometer as claimed in claim 23, wherein said drift region is maintained, in use, at a pressure such that a viscous drag is imposed upon ions passing through said drift region.

30. A mass spectrometer as claimed in claim 23, further comprising a pulsed ion source wherein in use a packet of ions emitted by said pulsed ion source enters said drift region.

31. A mass spectrometer as claimed in claims 23, further comprising an ion trap arranged upstream of said drift region wherein in use said ion trap releases a packet of ions which enters said drift region.

32. A mass spectrometer as claimed in claim 12, wherein said physico-chemical property is selected from the group consisting of: (i) elution time, hydrophobicity, hydrophilicity, migration time or chromatographic retention time; (ii) solubility; (iii) molecular volume or size; (iv) net charge, charge state, ionic charge or composite observed charge state; (v) isoelectric point (pI); (vi) dissociation constant (pKa); (vii) antibody affinity; (viii) electrophoretic mobility; (ix) ionisation potential; (x) dipole moment; and (xi)

hydrogen-bonding capability or hydrogen-bonding capacity.

33. A mass spectrometer as claimed in claim 11, wherein said ion trap has an entrance for receiving ions and an exit disposed at the other end of said ion trap to said entrance and wherein at a point in time said one or more axial trapping regions are translated towards said entrance.

34. A mass spectrometer as claimed in claim 11, wherein said ion trap has an entrance for receiving ions and an exit disposed at the other end of said ion trap to said entrance and wherein at a point in time said one or more axial trapping regions are translated towards said exit.

35. A mass spectrometer as claimed in claim 11, wherein a potential barrier between two or more axial trapping regions is removed so that said two or more trapping regions form a single trapping region or a potential barrier between two or more axial trapping regions is lowered so that at least some ions are able to be move between said two or more axial trapping regions.

36. A mass spectrometer as claimed in claim 11, wherein in use an axial voltage gradient is maintained along at least a portion of the length of said ion trap and wherein said axial voltage gradient varies with time.

37. A mass spectrometer as claimed in claim 11, wherein said ion trap comprises a first electrode held at a first reference potential, a second electrode held at a

second reference potential, and a third electrode held at a third reference potential, wherein:

at a time T_1 a first DC voltage is supplied to said first electrode so that said first electrode is held at a first potential above or below said first reference potential;

at a later time T_2 a second DC voltage is supplied to said second electrode so that said second electrode is held at a second potential above or below said second reference potential; and

at a later time T_3 a third DC voltage is supplied to said third electrode so that said third electrode is held at a third potential above or below said third reference potential.

38. A mass spectrometer as claimed in claim 37, wherein:

at said time T_1 said second electrode is at said second reference potential and said third electrode is at said third reference potential;

at said time T_2 said first electrode is at said first potential and said third electrode is at said third reference potential; and

at said time T_3 said first electrode is at said first potential and said second electrode is at said second potential.

39. A mass spectrometer as claimed in claim 37, wherein:

at said time T_1 said second electrode is at said second reference potential and said third electrode is at said third reference potential;

at said time T_2 said first electrode is no longer supplied with said first DC voltage so that said first electrode is returned to said first reference potential and said third electrode is at said third reference potential; and

at said time T_3 said second electrode is no longer supplied with said second DC voltage so that said second electrode is returned to said second reference potential and said first electrode is at said first reference potential.

40. A mass spectrometer as claimed in claim 37, wherein said first, second and third reference potentials are substantially the same and/or said first, second and third DC voltages are substantially the same and/or said first, second and third potentials are substantially the same.

41. A mass spectrometer as claimed in claim 11, wherein said ion trap comprises 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30 segments, wherein each segment comprises 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30 electrodes and wherein the electrodes in a segment are maintained at substantially the same DC potential.

42. A mass spectrometer as claimed in claim 41, wherein a plurality of segments are maintained at substantially the same DC potential.

43. A mass spectrometer as claimed in claim 41, wherein each segment is maintained at substantially the same DC potential as the subsequent nth segment wherein n is 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30.

44. A mass spectrometer as claimed in claim 11, wherein ions are: (i) radially confined within said ion trap by an AC or RF electric field; or (ii) radially confined within said ion trap in a pseudo-potential well and are constrained axially by a real potential barrier or well.

45. A mass spectrometer as claimed in claim 11, wherein the transit time of ions through said ion trap is selected from the group consisting of: (i) less than or equal to 20 ms; (ii) less than or equal to 10 ms; (iii) less than or equal to 5 ms; (iv) less than or equal to 1 ms; and (v) less than or equal to 0.5 ms.

46. A mass spectrometer as claimed in claim 11, wherein said ion trap is maintained, in use, at a pressure selected from the group consisting of: (i) greater than or equal to 0.0001 mbar; (ii) greater than or equal to 0.0005 mbar; (iii) greater than or equal to 0.001 mbar; (iv) greater than or equal to 0.005 mbar; (v) greater than or equal to 0.01 mbar; (vi) greater than or equal to 0.05 mbar; (vii) greater than or equal to 0.1 mbar; (viii) greater than or equal to 0.5 mbar; (ix) greater than or equal to 1 mbar; (x) greater than or equal to 5 mbar; and (xi) greater than or equal to 10 mbar.

47. A mass spectrometer as claimed in claim 11, wherein said ion trap is maintained, in use, at a pressure selected from the group consisting of: (i) less than or equal to 10 mbar; (ii) less than or equal to 5 mbar; (iii) less than or equal to 1 mbar; (iv) less than or equal to 0.5 mbar; (v) less than or equal to 0.1 mbar; (vi) less than or equal to 0.05 mbar; (vii) less than or equal to 0.01 mbar; (viii) less than or equal to 0.005 mbar; (ix) less than or equal to 0.001 mbar; (x) less than or equal to 0.0005 mbar; and (xi) less than or equal to 0.0001 mbar.

48. A mass spectrometer as claimed in claim 11, wherein said ion trap is maintained, in use, at a pressure selected from the group consisting of: (i) between 0.0001 and 10 mbar; (ii) between 0.0001 and 1 mbar; (iii) between 0.0001 and 0.1 mbar; (iv) between 0.0001 and 0.01 mbar; (v) between 0.0001 and 0.001 mbar; (vi) between 0.001 and 10 mbar; (vii) between 0.001 and 1 mbar; (viii) between 0.001 and 0.1 mbar; (ix) between 0.001 and 0.01 mbar; (x) between 0.01 and 10 mbar; (xi) between 0.01 and 1 mbar; (xii) between 0.01 and 0.1 mbar; (xiii) between 0.1 and 10 mbar; (xiv) between 0.1 and 1 mbar; and (xv) between 1 and 10 mbar.

49. A mass spectrometer as claimed in claim 11, wherein said ion trap is maintained, in use, at a pressure such that a viscous drag is imposed upon ions passing through or entering said ion trap.

50. A mass spectrometer as claimed in claim 11, wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are arranged to be progressively applied to the electrodes forming said ion trap so that ions are urged along said ion trap.

51. A mass spectrometer as claimed in claim 50, wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are applied to said electrodes at a first axial position along said ion trap and are then subsequently provided at second, then third different axial positions along said ion trap.

52. A mass spectrometer as claimed in claim 50, wherein said one of more transient DC voltages create: (i) a potential hill or barrier; (ii) a potential well; (iii) multiple potential hills or barriers; (iv) multiple potential wells; (v) a combination of a potential hill or barrier and a potential well; or (vi) a combination of multiple potential hills or barriers and multiple potential wells.

53. A mass spectrometer as claimed in claim 50, wherein said one or more transient DC voltage waveforms comprise a repeating waveform.

54. A mass spectrometer as claimed in claim 53, wherein said one or more transient DC voltage waveforms comprise a square wave.

55. A mass spectrometer as claimed in claim 50, wherein either: (i) the amplitude of said one or more transient DC voltages or said one or more transient DC voltage

waveforms remains substantially constant with time; or (ii) the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms varies with time.

56. A mass spectrometer as claimed in claim 50, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms either: (i) increases with time; (ii) increases then decreases with time; (iii) decreases with time; or (iv) decreases then increases with time.

57. A mass spectrometer as claimed in claims 50, wherein said ion trap comprises an upstream entrance region, a downstream exit region and an intermediate region, wherein:

in said entrance region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a first amplitude;

in said intermediate region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a second amplitude; and

in said exit region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a third amplitude.

58. A mass spectrometer as claimed in claim 57, wherein the entrance and/or exit region comprise a proportion of the total axial length of said ion trap selected from the group consisting of: (i) < 5%; (ii) 5-10%; (iii) 10-15%; (iv) 15-20%; (v) 20-25%; (vi) 25-30%; (vii) 30-35%; (viii) 35-40%; and (ix) 40-45%.

59. A mass spectrometer as claimed in claim 57, wherein said first and/or third amplitudes are substantially zero and said second amplitude is substantially non-zero.

60. A mass spectrometer as claimed in claim 57, wherein said second amplitude is larger than said first amplitude and/or said second amplitude is larger than said third amplitude.

61. A mass spectrometer as claimed in claim 11, wherein said one or more axial trapping regions are translated along said ion trap with a first velocity and cause ions within said ion trap to pass along said ion trap with a second velocity.

62. A mass spectrometer as claimed in claim 61, wherein the difference between said first velocity and said second velocity is selected from the group consisting of: (i) less than or equal to 50 m/s; (ii) less than or equal to 40 m/s; (iii) less than or equal to 30 m/s; (iv) less than or equal to 20 m/s; (v) less than or equal to 10 m/s; (vi) less than or equal to 5 m/s; and (vii) less than or equal to 1 m/s.

63. A mass spectrometer as claimed in claim 61, wherein said first velocity is selected from the group consisting of: (i) 10-250 m/s; (ii) 250-500 m/s; (iii) 500-750 m/s; (iv) 750-1000 m/s; (v) 1000-1250 m/s; (vi) 1250-1500 m/s; (vii) 1500-1750 m/s; (viii) 1750-2000 m/s; (ix) 2000-2250 m/s; (x) 2250-2500 m/s; (xi) 2500-2750 m/s; (xii) 2750-3000 m/s; (xiii) 3000-3250 m/s; (xiv) 3250-3500 m/s; (xv) 3500-3750 m/s; (xvi) 3750-4000

m/s; (xvii) 4000-4250 m/s; (xviii) 4250-4500 m/s; (xix) 4500-4750 m/s; (xx) 4750-5000 m/s; and (xxi) > 5000 m/s.

64. A mass spectrometer as claimed in claim 61, wherein said second velocity is selected from the group consisting of: (i) 10-250 m/s; (ii) 250-500 m/s; (iii) 500-750 m/s; (iv) 750-1000 m/s; (v) 1000-1250 m/s; (vi) 1250-1500 m/s; (vii) 1500-1750 m/s; (viii) 1750-2000 m/s; (ix) 2000-2250 m/s; (x) 2250-2500 m/s; (xi) 2500-2750 m/s; (xii) 2750-3000 m/s; (xiii) 3000-3250 m/s; (xiv) 3250-3500 m/s; (xv) 3500-3750 m/s; (xvi) 3750-4000 m/s; (xvii) 4000-4250 m/s; (xviii) 4250-4500 m/s; (xix) 4500-4750 m/s; (xx) 4750-5000 m/s; and (xxi) > 5000 m/s.

65. A mass spectrometer as claimed in claim 61, wherein said second velocity is substantially the same as said first velocity.

66. A mass spectrometer as claimed in claim 50, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms applied to the electrodes forming said ion trap have a frequency, and wherein said frequency: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

67. A mass spectrometer as claimed in claim 50, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms applied to the electrodes forming said ion trap have a wavelength, and wherein said wavelength: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases

then decreases; (v) decreases; or (vi) decreases then increases.

68. A mass spectrometer as claimed in claim 11, wherein two or more transient DC voltages or two or more transient DC voltage waveforms are arranged to be applied to the electrodes forming said ion trap substantially simultaneously.

69. A mass spectrometer as claimed in claim 68, wherein said two or more transient DC voltages or said two or more transient DC voltage waveforms applied to the electrodes forming said ion trap are arranged so that potential barriers or potential wells move: (i) in the same direction; (ii) in opposite directions; (iii) towards each other; or (iv) away from each other.

70. A mass spectrometer as claimed in claim 50, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are repeatedly generated and applied to the electrodes forming said ion trap, and wherein the frequency of generating said one or more transient DC voltages or said one or more transient DC voltage waveforms either: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

71. A mass spectrometer as claimed in claim 11, further comprising a Time of Flight mass analyser comprising an electrode for injecting ions into a drift region, said electrode being arranged to be energised in use in a

substantially synchronised manner with a pulse of ions emitted from the exit of said ion trap.

72. A mass spectrometer as claimed in claim 11, wherein said ion trap is selected from the group consisting of: (i) an ion funnel comprising a plurality of electrodes having apertures therein through which ions are transmitted, wherein the diameter of said apertures becomes progressively smaller or larger; (ii) an ion tunnel comprising a plurality of electrodes having apertures therein through which ions are transmitted, wherein the diameter of said apertures are substantially constant; and (iii) a stack of plate, ring or wire loop electrodes.

73. A mass spectrometer as claimed in claim 11, wherein said ion trap comprises a plurality of electrodes, each electrode having an aperture through which ions are transmitted in use.

74. A mass spectrometer as claimed in claim 11, wherein at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95% or 100% of said electrodes have a substantially circular apertures.

75. A mass spectrometer as claimed in claim 11, wherein each electrode has a single aperture through which ions are transmitted in use.

76. A mass spectrometer as claimed in claim 73, wherein the diameter of the apertures of at least 50%, 60%, 70%, 80%, 90%, 95% or 100% of the electrodes forming said ion trap is selected from the group consisting of: (i) less

than or equal to 10 mm; (ii) less than or equal to 9 mm; (iii) less than or equal to 8 mm; (iv) less than or equal to 7 mm; (v) less than or equal to 6 mm; (vi) less than or equal to 5 mm; (vii) less than or equal to 4 mm; (viii) less than or equal to 3 mm; (ix) less than or equal to 2 mm; and (x) less than or equal to 1 mm.

77. A mass spectrometer as claimed in claim 11, wherein at least 50%, 60%, 70%, 80%, 90%, 95% or 100% of the electrodes forming the ion trap have apertures which are substantially the same size or area.

78. A mass spectrometer as claimed in claim 11, wherein said ion trap comprises a segmented rod set.

79. A mass spectrometer as claimed in claim 11, wherein said ion trap consists of: (i) 10-20 electrodes; (ii) 20-30 electrodes; (iii) 30-40 electrodes; (iv) 40-50 electrodes; (v) 50-60 electrodes; (vi) 60-70 electrodes; (vii) 70-80 electrodes; (viii) 80-90 electrodes; (ix) 90-100 electrodes; (x) 100-110 electrodes; (xi) 110-120 electrodes; (xii) 120-130 electrodes; (xiii) 130-140 electrodes; (xiv) 140-150 electrodes; or (xv) more than 150 electrodes.

80. A mass spectrometer as claimed in claim 11, wherein the thickness of at least 50%, 60%, 70%, 80%, 90%, 95% or 100% of said electrodes is selected from the group consisting of: (i) less than or equal to 3 mm; (ii) less than or equal to 2.5 mm; (iii) less than or equal to 2.0 mm; (iv) less than or equal to 1.5 mm; (v) less than or equal to 1.0 mm; and (vi) less than or equal to 0.5 mm.

81. A mass spectrometer as claimed in claim 11, wherein said ion trap has a length selected from the group consisting of: (i) less than 5 cm; (ii) 5-10 cm; (iii) 10-15 cm; (iv) 15-20 cm; (v) 20-25 cm; (vi) 25-30 cm; and (vii) greater than 30 cm.

82. A mass spectrometer as claimed in claim 11, wherein at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95% or 100% of said electrodes are connected to both a DC and an AC or RF voltage supply.

83. A mass spectrometer as claimed in claim 11, wherein axially adjacent electrodes are supplied with AC or RF voltages having a phase difference of 180°.

84. A mass spectrometer as claimed in claim 11, wherein in use one or more AC or RF voltage waveforms are applied to at least some of said electrodes so that ions are urged along at least a portion of the length of said ion trap.

85. A mass spectrometer as claimed in claim 11, further comprising an ion source selected from the group consisting of: (i) an Electrospray ("ESI") ion source; (ii) an Atmospheric Pressure Chemical Ionisation ("APCI") ion source; (iii) an Atmospheric Pressure Photo Ionisation ("APPI") ion source; (iv) an Inductively Coupled Plasma ("ICP") ion source; (v) an Electron Impact ("EI) ion source; (vi) an Chemical Ionisation ("CI") ion source; (vii) a Fast Atom Bombardment ("FAB") ion source; (viii) a Liquid Secondary Ions Mass Spectrometry ("LSIMS") ion source; (ix) a Matrix Assisted Laser Desorption Ionisation ("MALDI") ion

source; and (x) a Laser Desorption Ionisation ("LDI") ion source.

86. A mass spectrometer as claimed in claim 11, wherein in a mode of operation said one or more axial trapping regions are translated, in use, along said ion trap with a velocity which: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; (vi) decreases then increases; (vii) reduces to substantially zero; (viii) reverses direction; or (ix) reduces to substantially zero and then reverses direction.

87. A mass spectrometer as claimed in claim 11, wherein in use pulses of ions emerge from an exit of said ion trap.

88. A mass spectrometer as claimed in claim 11, wherein in use a complex mixture of ions is arranged to be trapped within said ion trap.

89. A mass spectrometer as claimed in claim 88, wherein said complex mixture comprises at least 5, 10, 15, 20, 25, 30, 35, 40, 50, 55, 60, 65, 70, 75, 80, 90, 95, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950 or 1000 different species of ions, each species of ions having a substantially different mass to charge ratio.

90. A mass spectrometer as claimed in claim 88, further comprising a Matrix Assisted Laser Desorption Ionisation (MALDI) ion source.

91. A mass spectrometer as claimed in claim 11, wherein, in use, a complex mixture of ions is received into said ion trap and is fractionated by said ion trap, wherein at least some of said fractions are stored in separate axial trapping regions.

92. A mass spectrometer as claimed in claim 11, wherein in a mode of operation ions are ejected or allowed to exit from one or more axial trapping regions for subsequent mass analysis or for further experimentation.

93. A mass spectrometer as claimed in claim 92, wherein further experimentation comprises fragmentation and/or mass to charge ratio separation and/or ion mobility separation.

94. A method of mass spectrometry comprising:

providing an ion trap comprising a plurality of electrodes wherein at a first time t_1 ions enter said ion trap; and

forming or creating one or more axial trapping regions at a second later time t_2 along at least a portion of the length of said ion trap.

95. A method of mass spectrometry comprising:

providing an ion trap comprising a plurality of electrodes;

receiving ions within said ion trap;

trapping said ions in one or more axial trapping regions within said ion trap;

translating said one or more axial trapping regions along at least a portion of the axial length of said ion trap with an initial first velocity; and

progressively reducing said first velocity to a velocity less than or equal to 50 m/s.

96. A method of mass spectrometry comprising:

providing an ion trap comprising a plurality of electrodes;

receiving ions within said ion trap;

trapping said ions in one or more axial trapping regions within said ion trap;

translating said one or more axial trapping regions along at least a portion of the axial length of said ion trap with an initial first velocity; and

progressively reducing said first velocity to substantially zero.